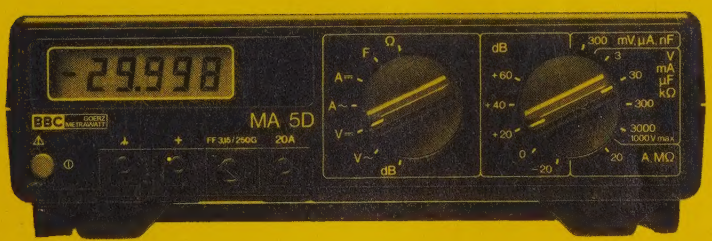
BBC BROWN BOVERI GOERZ METRAWATT

SE LABS

INSTRUCTIONS FOR SERVICE AND MAINTENANCE

Digital Multimeter MA 5D

3.338.247.03 Issue 9.81 L 2-5.3



MP MASTER
MA34330

Digital Multimeter MA 5D

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1. GENERAL

These service instructions contain the most essential information required for the replacement of defective assembly units in the case of failure.

The experienced repair technician, disposing of proper measuring means, shall thus be enabled to perform simple repair and maintenance work.

NOTE: Any warranty becomes voided if attempts are made to perform unauthorized work during the warranty period.

For warranty repair ship the units to:

METRAWATT GmbH
Service
Thomas-Mann-Strasse 16-20

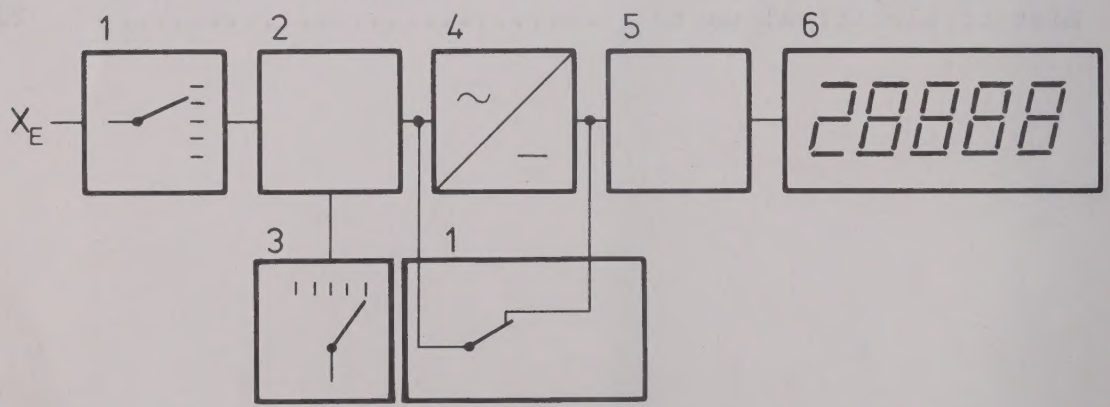
D-8500 Nürnberg

When ordering replacement parts, please specify type of unit, description and part number.

Replacement parts for which the part number is not given cannot be supplied.

2. FUNCTIONAL DESCRIPTION

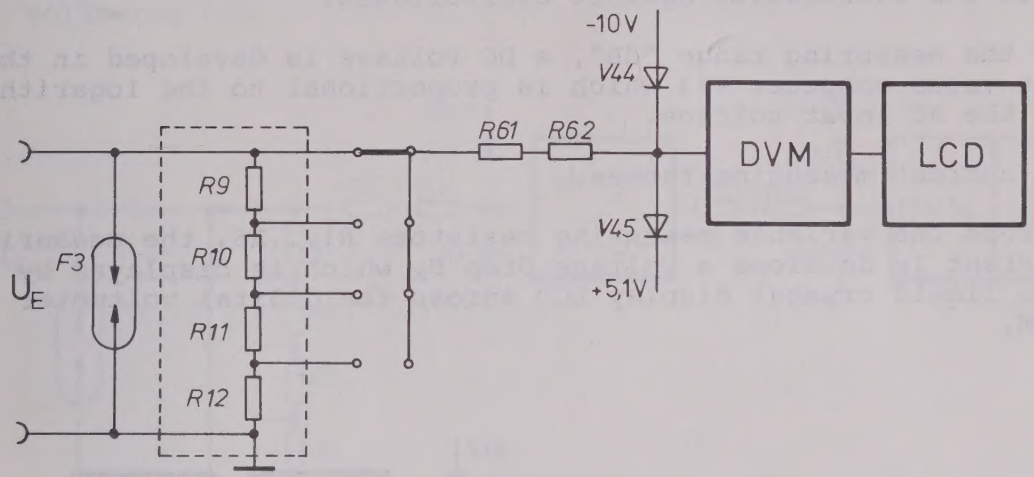
The input variable X_E is switched to the corresponding measuring circuitry 2 across function switch 1. Within the measuring circuitry 2, the corresponding measuring range is selected with the range selector switch 3. Part of the function switch 1 connects the rms value converter 4 into the output line of the measuring circuitry 2 when measuring AC voltage and AC current. On the other measuring ranges, the output variable of the measuring circuitry 2 is directly passed to the digital unit 5 and the digital display 6.



A built-in power supply unit provides the required auxiliary voltages to the measuring electronics, and in addition charges the built-in storage battery in the case of mains operation.

The following measuring circuitries are used. (The short codes used for the parts are identical with those in the wiring diagram.)

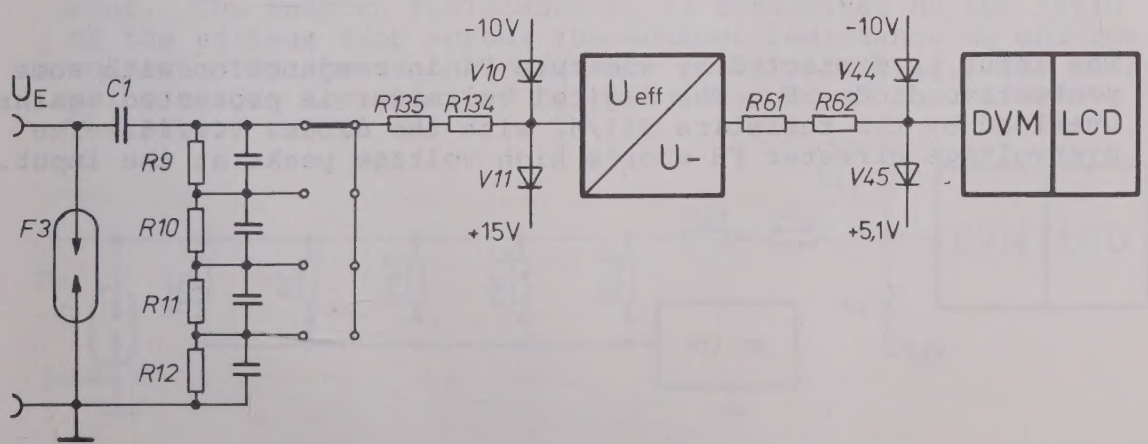
2.1. DC voltage measuring ranges



The measuring voltage U_E is divided down to the measuring voltage U_X across an integrated voltage divider R9...12, passed to the proper circuitry of the digital voltmeter DVM across the protective network R61, 62, V44, 45 and displayed by the liquid crystal display LCD. An overvoltage arrester F3 and the protective network protect the measuring electronics against dangerous overvoltages.

2.2. AC voltage measuring ranges, dB

The measuring voltage U_E is divided down to the measuring voltage U_X across an integrated voltage divider R9...12. With the capacitors C2...12 and C60 which are connected in parallel, the impedance of the divider resistors is balanced in such a way that the display becomes frequency-independent on the low-frequency range.

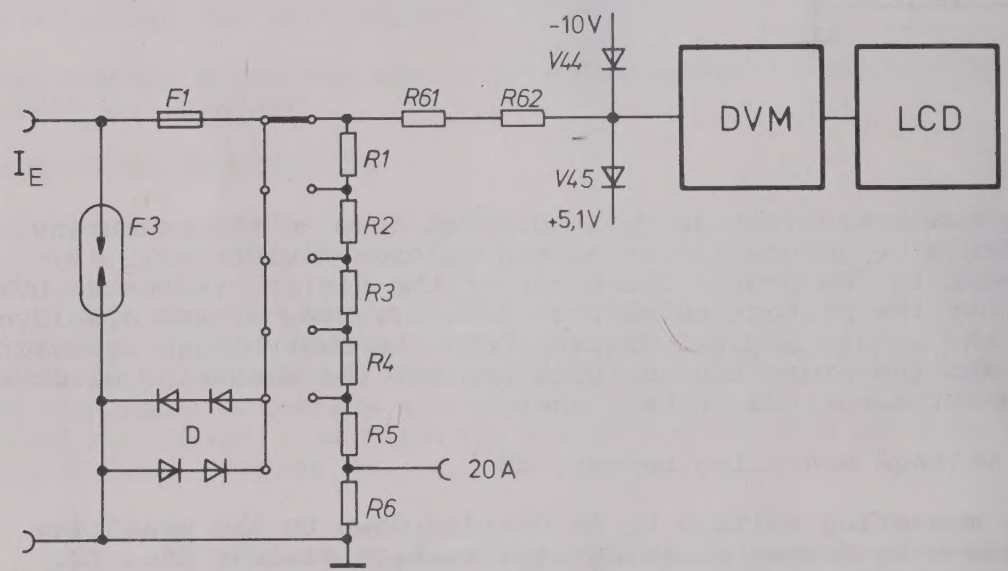


In the rms value computer V43, the AC measuring voltage U_X is converted into a DC voltage which is proportional to the rms value of the measuring voltage U_X. The measuring voltage X_E is displayed by the proper circuitry of the digital voltmeter DVM and the liquid crystal display LCD. The protective network F3 as well as R134/135 - V10/11 and R61/62 - V44/45 protect the electronics against overvoltages.

On the measuring range "dB", a DC voltage is developed in the rms value computer V43 which is proportional to the logarithm of the AC input voltage.

2.3. DC current measuring ranges

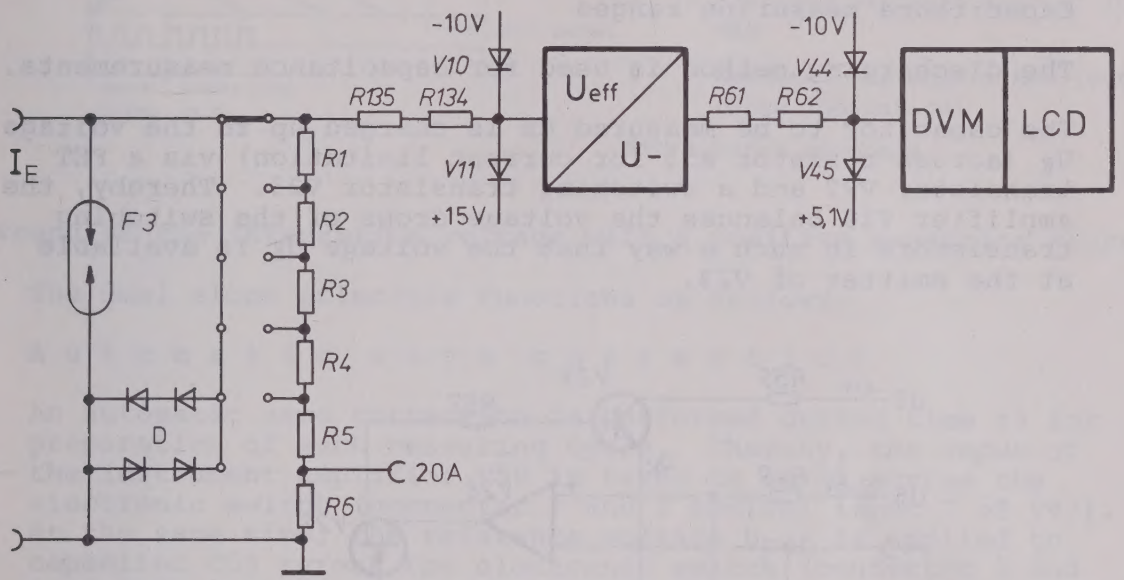
Across the variable measuring resistors R1...R6, the measuring current I_E develops a voltage drop U_X which is displayed by the liquid crystal display LCD across the digital voltmeter DVM.



The input is protected by the fuse F1 in conjunction with some protective diodes D. The digital voltmeter is protected against overload by the resistors R61/62 with the diodes V44/45. The overvoltage arrester F3 shorts high voltage peaks at the input.

2.4. AC current measuring ranges

Same as on the DC current measuring ranges, the measuring current I_E develops a voltage drop U_x on the variable measuring resistors R1...R6. A DC voltage proportional to the rms value of U_x is developed in the rms computer and indicated on the liquid crystal display LCD across the digital voltmeter DVM.

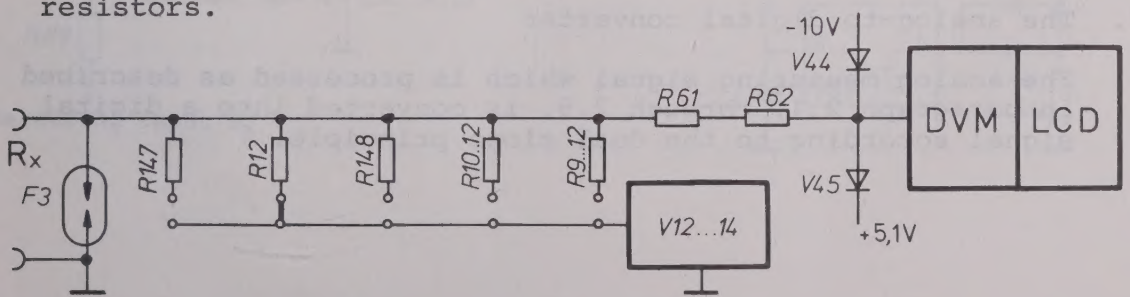


The input is protected against overload by the fuse F1 in conjunction with some protective diodes D, the rms value computer V43 is protected by the resistors R135/134 with the diodes V10/11, and the DVM by the resistors R61/62 and the diodes V44/45.

The overvoltage arrester F3 shorts high voltage peaks at the input.

2.5. Resistance measuring ranges

The resistance R_x is determined by means of a ratio measurement. The unknown resistance R_x is determined by the ratio of the voltage drop across the unknown resistance R_x and the voltage drop across the reference resistance R_{ref}. The measuring ranges are obtained by changing-over of the reference resistors.



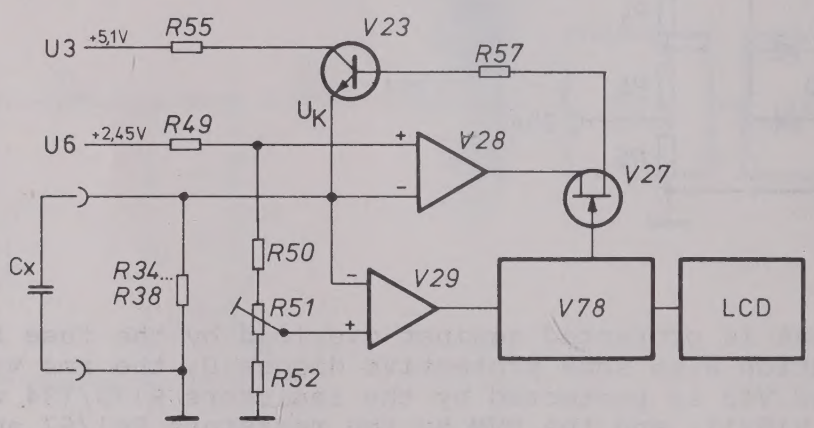
On the "3 kΩ" measuring range, a constant current of 0.5 mA is applied to the reference resistance and the unknown resistance across a transistor circuitry V12...V14. On the "30 kΩ ...20 MΩ" measuring range, the transistor circuitry V12...V14 acts as constant voltage source of + 2.2 V.

The spark gap F3 as well as the resistors R61, R62 and the diodes V44, V45 protect the measuring circuitry against damage due to overvoltage.

2.6. Capacitance measuring ranges

The discharging method is used for capacitance measurements.

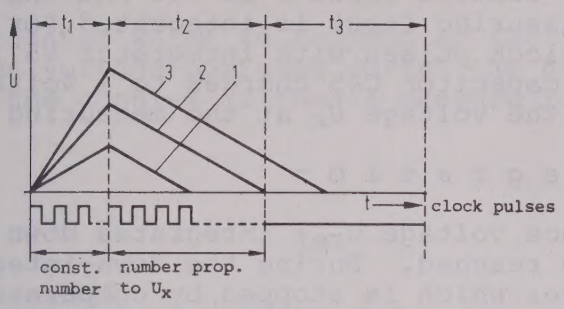
The capacitor to be measured Cx is charged up to the voltage U_K (across resistor R55 for current limitation) via a FET transistor V27 and a switching transistor V23. Thereby, the amplifier V28 balances the voltage drops of the switching transistors in such a way that the voltage U_K is available at the emitter of V23.



After charging, the digital display starts to count the clock pulses and at the same time the capacitor Cx is discharged by the range-depending discharging resistors R34...R38 until the voltage threshold $\frac{U_K}{e}$ which is adjustable with potentiometer R51 is obtained. At this instant, the comparator V29 stops the counter and the capacitance value, proportional to the discharge time, is digitally displayed.

2.7. The analog-to-digital converter

The analog measuring signal which is processed as described in paragraph 2.1. through 2.5. is converted into a digital signal according to the dual slope principle.



1 = Measured variable approx. 50% MBU

2 = Measured variable approx. 100% MBU

3 = Measured variable > MBU (over-range indication)

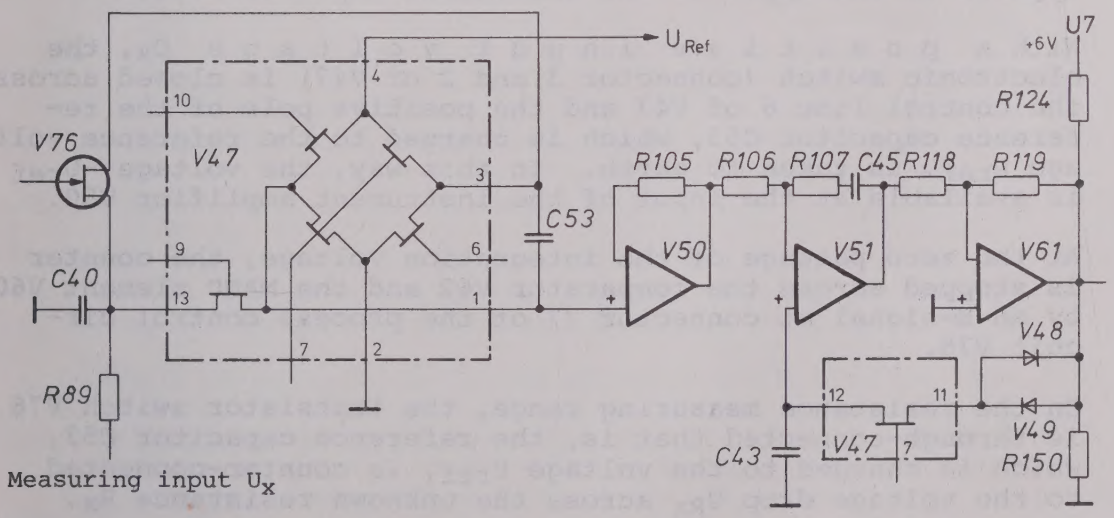
MBU = Range coverage

Trend of the integration voltage with a positive measuring signal

The dual slope principle functions as follows:

A u t o m a t i c z e r o c o r r e c t i o n

An automatic zero correction is performed during time t3 for preparation of each measuring cycle. Thereby, the input of the instrument amplifier V50 is taken to earth across the electronic switch (connector 1 and 2 control input 7 of V47). At the same time, the reference voltage U_{ref} is applied to capacitor C53 across the electronic switch (connector 3 and 4 of V47) and the capacitor charged up to U_{ref}. At the same time, capacitor C43 is charged to the sum of all offset error voltages across the electronic switch (connector 11 and 12 of V47). This voltage is stored as correction voltage during the measuring time $t_1 + t_2$ by C43 at the positive input of amplifier V51.



Signal integration

During time t1, the electronic switch (connector 13 and 1 of V47) is closed across the control input 9 of V47 and the measuring signal U_x of the measuring input is integrated for a constant time of 10,000 clock pulses with integrator V51. Thereby, the integration capacitor C45 charges to a voltage which is proportional to the voltage U_x at the measuring input.

Reference integration

During time t2, a reference voltage U_{ref} integrates down until the zero passage is again reached. During the down-integration time t2, a counter operates which is stopped by comparator V62 at the zero passage of the integration voltage. The content of the counter is then proportional to the measuring voltage U_x.

The reference voltage is changed over with the two transistor switches V52 and V53. Thereby, the following reference voltages U_{ref} are provided:

Measuring ranges	U_{ref}	Selector switch
300 mV DC and DC current	100 mV	V52
3 V DC...1000 V DC 0.3 V AC...1000 V AC DC current	1 V	V53

Reference integration takes place as follows:

With a negative input voltage $-U_x$, the electronic switch (connector 4 and 1 of V47) is closed across the control line 10 of V47 and the reference voltage U_{ref} is applied to the input of the instrument amplifier V50.

With a positive input voltage U_x, the electronic switch (connector 3 and 2 of V47) is closed across the control line 6 of V47 and the positive pole of the reference capacitor C53, which is charged to the reference voltage U_{ref}, is taken to earth. In this way, the voltage $-U_{ref}$ is available at the input of the instrument amplifier V50.

At the zero passage of the integration voltage, the counter is stopped across the comparator V62 and the NAND element V60 by an H-signal at connector 27 of the process control circuit V78.

On the resistance measuring range, the transistor switch V76 is through-connected that is, the reference capacitor C53, which is charged to the voltage U_{ref}, is counter-connected to the voltage drop U_{RX} across the unknown resistance R_x.

The reference voltage for the resistance measuring ranges is thus provided

$$U_{rf} = U_{Rx} - U_{ref}$$

A counter which is stopped at the zero passage of the integration voltage operates during the down-integration. The content of the counter is then a measure for the unknown resistance.

3. BALANCING INFORMATION

Note the indicated order of the balancing procedure. Circuit board completely equipped, installed in the shielded upper part of the case. Front panel complete and sockets soldered on. If possible, always balance to the desired value.

3.1. Measuring means required

1. Resistance decade, 100Ω ...1 kΩ, 2%
2. Sensor, ± 0.01%, 0...3.000 V DC
3. Sensor, ± 0.05%, 0...100.0 V AC, 60 Hz...20 kHz
4. Resistance decade, 10 kΩ ...1 MΩ, 2%
5. Sensor, ± 0.05%, 1 A/10 A DC
6. Calibration capacitor, 200 µF ± 0.2%, and plastic foil capacitor, 22 pF ± 5%

3.2. Balancing the DC voltage measuring ranges

1. Turn on the instrument and wait approximately 5 minutes for warm-up.
2. Set the range selector switch to 300 mV DC.
3. Connect a resistance decade according to 3.1.1. in place of resistor R109.
4. Connect a sensor according to 3.2.2. to the input connectors + and ⊥ and adjust to 0 mV.
5. With potentiometer R92, balance the zero position to 0.00 mV.
6. Set potentiometer R111 to mid-position.
7. Adjust a sensor according to 3.2.4. to 290.00 mV.
8. With a resistance decade according to 3.2.3., make a coarse adjustment of the display to 290.0 mV.
9. Remove the resistance decade according to 3.2.3. and solder in the next closest standard value for R109. After soldering, wait some minutes for the resistor to cool to room temperature.
10. With potentiometer R111, balance the display to 289.99... 290.01 mV.
11. Set the range selector switch to 3 V DC.
12. Set potentiometer R99 to mid-position.
13. Adjust the sensor according to 3.2.4. to 2.9000 V.
14. Connect a resistance decade according to 3.1.1. in place of resistor R97.
15. With a resistance decade according to 3.2.14., make a coarse adjustment of the display to 2.90 V.
16. Remove the resistance decade according to 3.2.15. and solder in the next closest standard value for R97. After soldering, wait some minutes for the resistor to cool to room temperature.
17. With potentiometer R99, balance the display to 2.8999... 2.9001 V.
18. With half the input voltage of 1.4500 V, the display must read 1.4497...1.4503 V.

3.3. Balancing the AC voltage measuring ranges

1. Turn on the instrument and wait approximately 5 minutes for warm-up.
2. Set the range selector switch to 3 V AC.
3. Connect a sensor according to 3.1.3. to the input connectors + and ⊥ and adjust to 0.0000 V.
4. With potentiometer R33, balance the zero position to 0.0000...0.0003.
5. Adjust a sensor according to 3.3.3. to 2.9000 V, 60 Hz.
6. With potentiometer R26, balance the display to 2.8998... 2.9002 V.
7. Set the range selector switch to 300 mV AC.
8. Adjust the sensor according to 3.3.3. to 290.00 mV, 60 Hz.
9. With potentiometer R24, balance the display to 289.98... 290.02 mV.

3.4. Balancing the frequency compensation

1. Set the balancing capacitors C10 to C15 to mid-position.
2. Set the range selector switch to position 3 V AC.
3. Connect a sensor according to 3.1.3. to the input connectors + and ⊥ and adjust to 2.0000 V, 20 kHz.
4. With balancing capacitor C15, balance the display to 1.9990...2.0010 V.
5. Set the range selector switch to 300 mV AC.
6. Adjust the sensor according to 3.4.3. to 200.00 mV, 20 kHz.
7. With balancing capacitor C13, balance the display to 199.90...200.10 mV.
8. Set the range selector switch to 3 V AC.
9. Adjust the sensor according to 3.4.3. to 0.1000 V, 20 kHz.
10. The display may read between 0.0975 and 0.1025 V. Note the indicated value (in digits).
11. Set the range selector switch to 1000 V AC.
12. Adjust the sensor according to 3.4.3. to 100.0 V, 20 kHz.
13. With balancing capacitor C12, adjust the display as described in 3.4.10. Tolerance ± 2 digits at a maximum.
14. Set the range selector switch to 300 V AC.
15. Adjust the sensor according to 3.4.3. to 10.00 V, 20 kHz.
16. With balancing capacitor C10, adjust the display as described in 3.4.10. Tolerance ± 2 digits at a maximum.
17. Set the range selector switch to 30 V AC.
18. Adjust the sensor according to 3.4.3. to 20.000 V, 20 kHz.
19. With balancing capacitor C11, adjust to 20.000. Tolerance ± 2 digits at a maximum.

3.5. Balancing the measuring range "dB"

1. Set the range selector switch to 0 dB.
2. Connect a sensor according to 3.1.3. to the input connectors + and ⊥ and adjust to 0.7746 V, 60 Hz.
3. Set potentiometer R53 to mid-position.
4. Connect a resistance decade according to 3.1.4. in place of resistor R54.
5. With the resistance decade according to 3.5.4., make a coarse adjustment of the display to 0 dB.

6. Remove the resistance decade according to 3.5.5. and solder in the next closest standard value for R54. After soldering, wait some minutes for the resistor to cool to room temperature.
7. With potentiometer R53, balance the display to -0.02... + 0.02 dB.
8. Adjust the sensor according to 3.5.2. to 77.46 mV, 60 Hz.
9. With potentiometer R59, balance the display to -20.01... -19.99 dB.
10. Set the range selector switch to + 20 dB. Adjust the sensor according to 3.5.2. to 77.46 mV, 60 Hz. Thereby, the display must read -40.50...-39.50 dB.

3.6. Balancing the current measuring ranges

CAUTION! It is not permissible to solder when balancing the shunts.

1. Set the range selector switch to 20 A DC.
2. Connect a sensor, 10 A DC, according to 3.1.5. to connectors 20 A and ⊥ .
3. Balance the display to 9.99...10.01 A, if required by equal cutting of the current shunts R6 and R138. This is only possible when the display is too small. If the display is too high, it is required to replace the shunt.
4. Connect a sensor, 1 A DC, to the input connectors + and ⊥ .
5. Set the range selector switch to 3 A DC.
6. Balance the display to 0.999...1.001 A, if required by cutting shunt R5.

3.7. Balancing the capacitance measuring circuitry

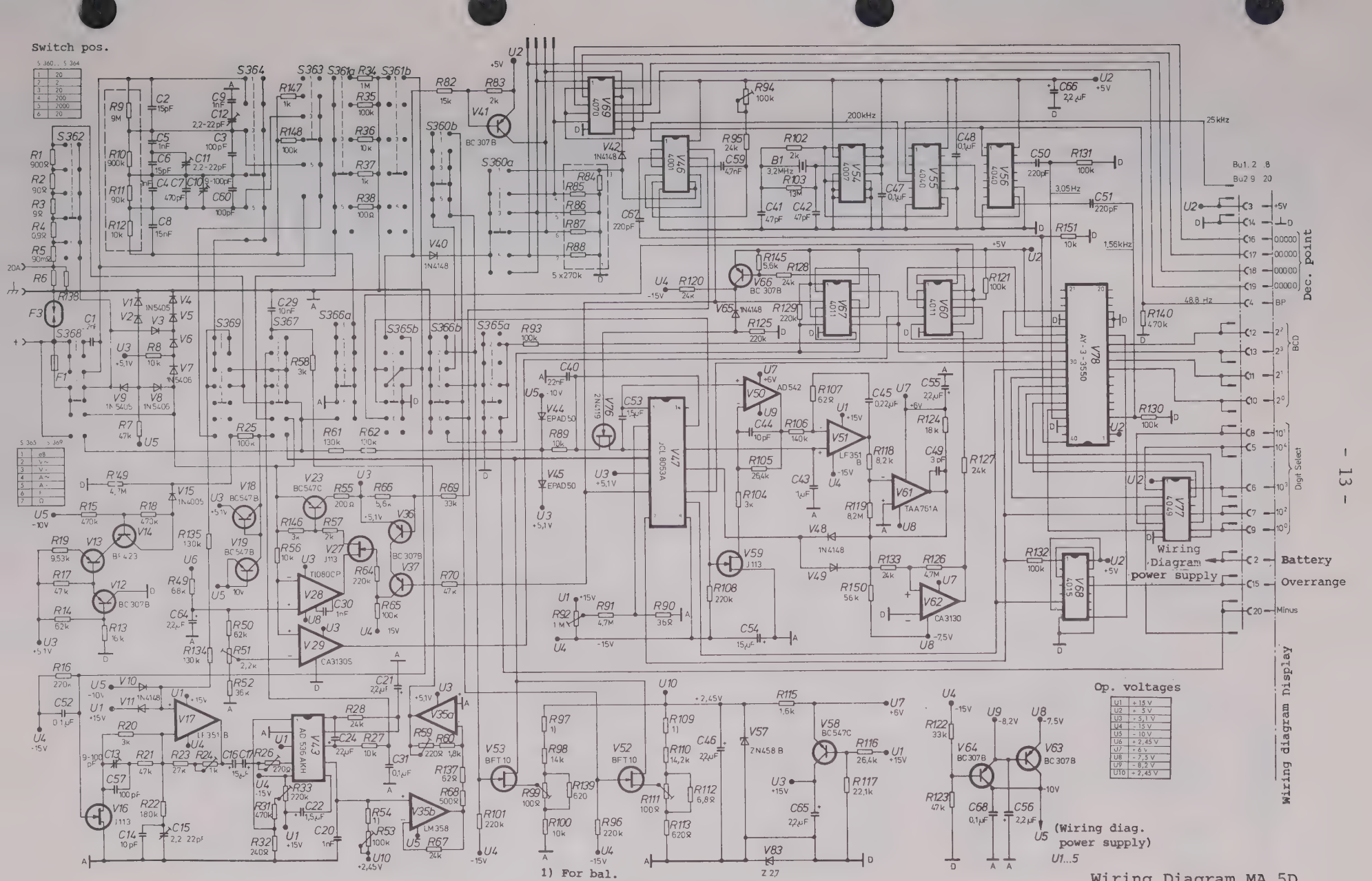
1. Set the range selector switch to 300 µF.
2. Connect a sensor, 200 µF ± 0.2%, according to 3.1.6. to the input connectors + and ⊥ .
3. With potentiometer R51, balance the display to 199.90... 200.10 µF.
4. Set the range selector switch to 300 nF.
5. Connect a plastic foil capacitor, 22 pF ± 5%, directly to the input connectors + and ⊥ .
6. With potentiometer R94, balance the zero to a display of 0.01...0.04 nF.

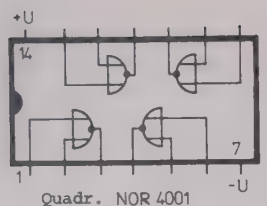
3.8. Testing the battery indication

1. Battery voltage at ≥ 4 V = clock dots of the LCD do not light.
2. Battery voltage at 3.4...3.6 V = clock dots of the LCD light additionally.
3. Battery voltage at ≤ 2.8 V = LCD will no longer light.
4. The current consumption of the instrument on the measuring range 3 V DC, with open input terminals and a battery voltage of 5.0 V DC, amounts to 90...160 mA.

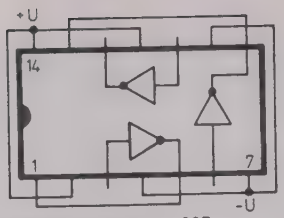
3.9. Testing the overrange display

1. If the full scale value of 29998 ± 1 digit is exceeded, only the "2" and the range decimal point light.

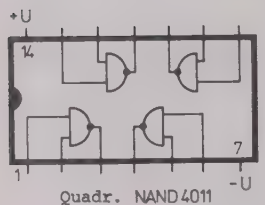

Switch pos.
Wiring Diagram power supply
Battery
Overrange
Minus
Dec. point
BCD
Digit Select
Wiring diagram display
Op. voltages
(Wiring diag. power supply)
U1...5
1) For bal.
Wiring Diagram MA 5D



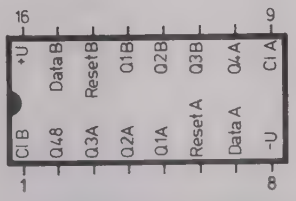
Quadr. NOR 4001



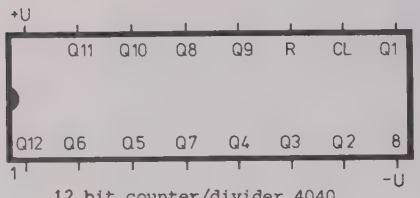
Triple inverter 4007



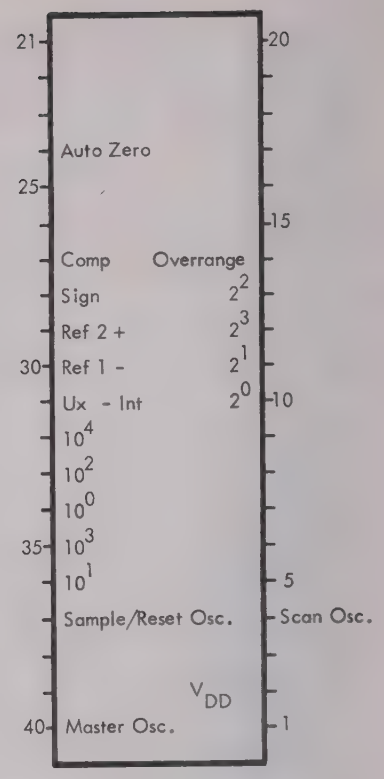
Quadr. NAND 4011



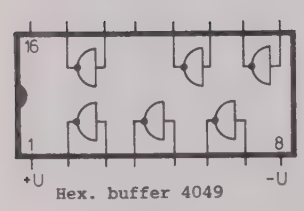
Dual four-stage shift reg. 4015



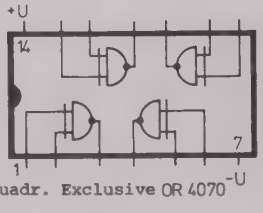
12 bit counter/divider 4040



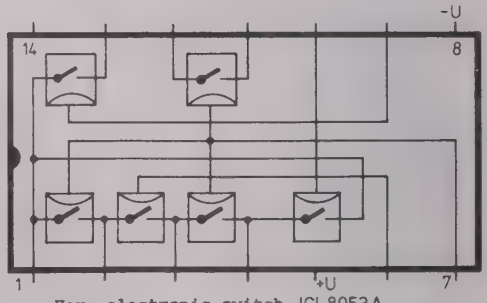
AY-3-3550



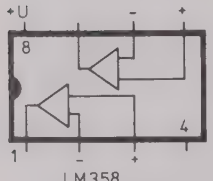
Hex. buffer 4049



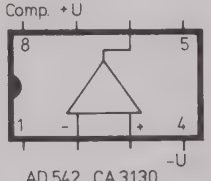
Quadr. Exclusive OR 4070



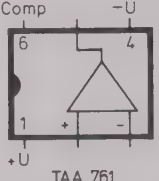
Hex. electronic switch ICL 8053A



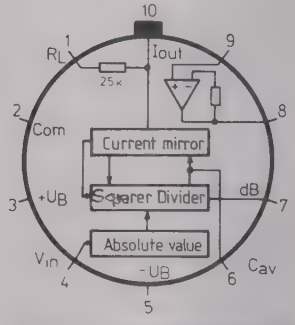
LM 358



AD 542, CA 3130,
LF 351, LM 308, TL 080



TAA 761

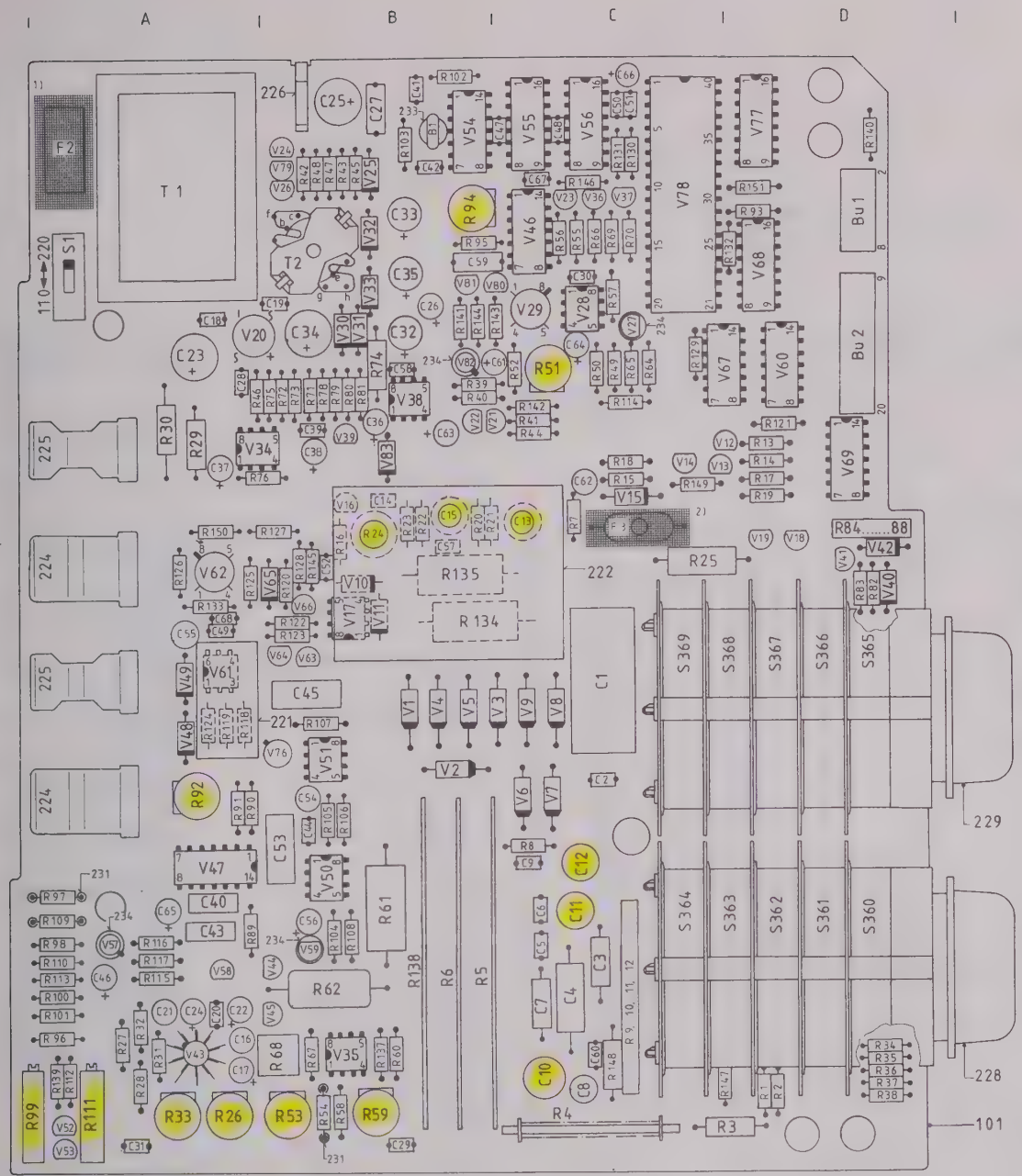


RMS value computer AD 536 AKH

2N4119 BFT10 J113 BC635 BF423 BC307 BC547

Top view Semiconductor Components

Wiring Diagram MA 5D



Circuit Board MA 5D, equipped
2.582.466.02 Design State D

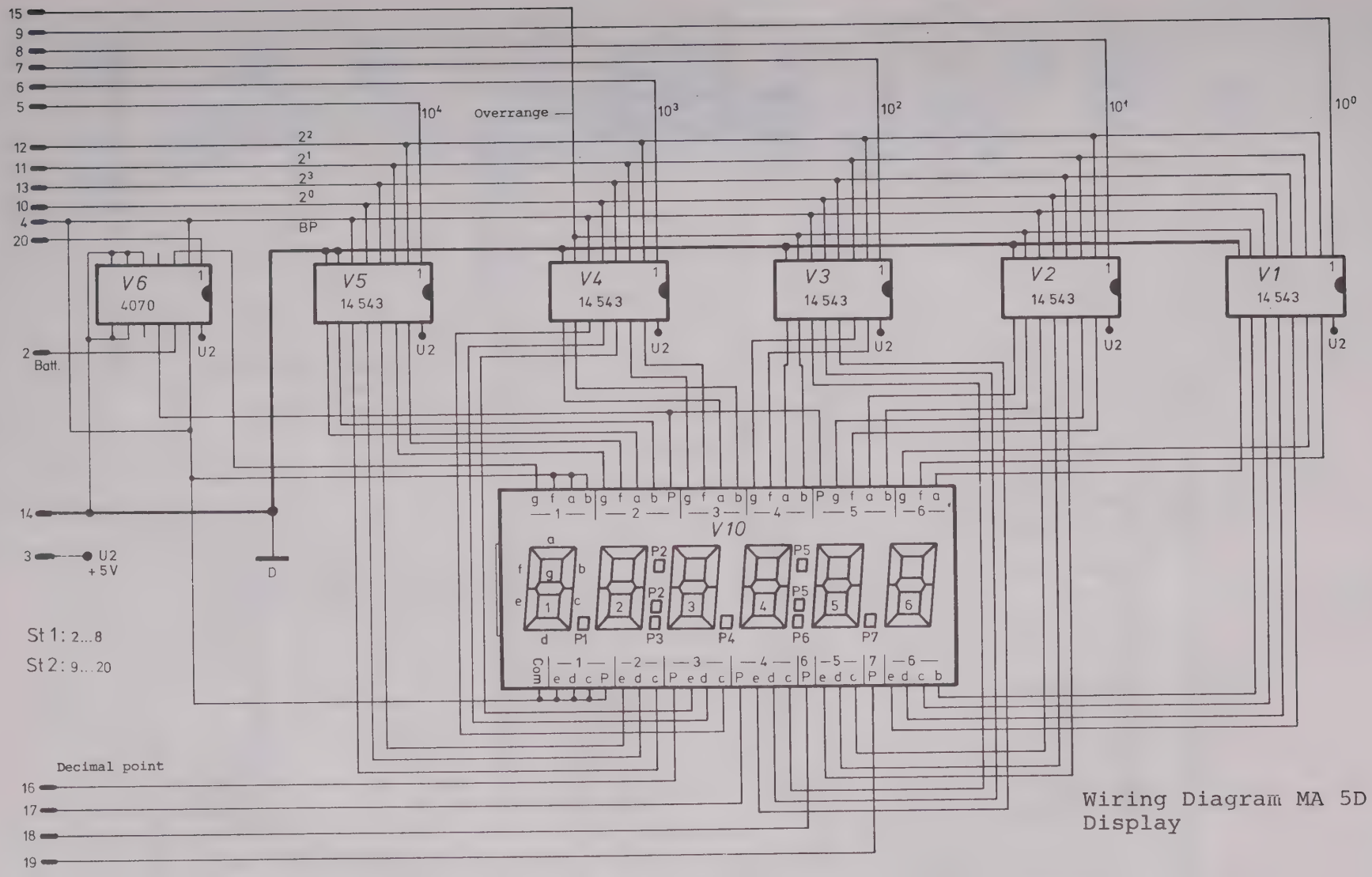
Part Finder Circuit Board MA 5D

Part	Square
B1	B5
Bu1,2	D4/5
C1	C2/3
C2	C2
C3,4,5	C1
C6	C2
C7,8	C1
C9	C2
C10	C1
C11,12	C2
C13	C3
C14,15	B3
C16,17	A1
C18	A4
C19	B4
C20,21,22	A1
C23	A4
C24	A1
C25	B5
C26	B4
C27	B5
C28	A4
C29	B1
C30	C4
C31	A1
C32	B4
C33	B5
C34,35,36	B4
C37	A4
C38,39	B4
C40	A2
C41,42	B5
C43	A2
C44	B2
C45	B3
C46	A1
C47,48	C5
C49	A3
C50,51	C5
C52	B3
C53,54	B2
C55	A3
C56	B2
C57	B3
C58,59	B4
C60	C1
C61	C4
C62	C3
C63	B4
C64	C4
C65	A2
C66,67	C5

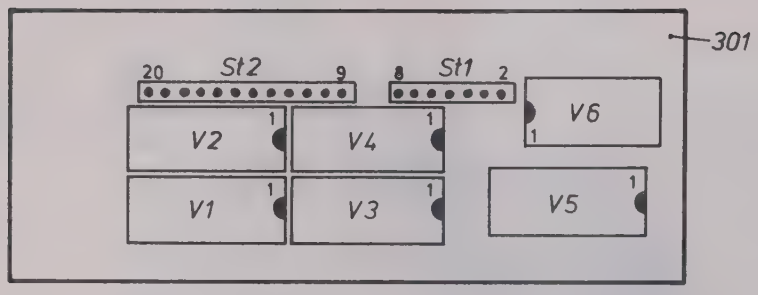
Part	Square
C68	A3
F1	Front panel
F2	Mains plug
F3	C3
R1,2	D1
R3	C/D1
R4	C1
R5	C1/2
R6	B1/2
R7	C3
R8	C2
R9...12	C1/2
R14	D4
R14	D3
R15	C3
R16	B3
R17	D3
R18	C4
R19	D3
R20	B3
R21	B/C3
R22,23,24	B3
R25	C3
R26,27,28	A1
R29,30	A4
R31,32,33	A1
R34..38	D1
R39,40	B4
R41	C4
R42,43	B5
R44	C4
R45	B5
R46	A4
R47,48	B5
R49...52	C4
R53,54	B1
R55,56	C5
R57	C4
R58...60	B1
R61	B2
R62	B1
R64,65	C4
R66	C5
R68	B1
R69,70	C5
R71...75	B4
R76	A/B4
R78...81	B4
R82,83	D3
R84...88	D3
R89...92	A2

Part	Square
R93	D5
R94,95	B5
R96	A1
R97,98	A2
R99...101	A1
R102,103	B5
R104	B1/2
R105...107	B2
R108	B1/2
R109	A2
R110...113	A1
R115	A1
R116	A1/2
R117	A1
R118,119	A2
R120	B3
R121	D4
R122,123	B3
R124	A2
R125,126	A3
R127	A/B3
R128	B3
R129	C4
R130,131	C5
R132	D4
R133	A3
R134,135	B/C3
R137	B1
R138	B1/2
R139	A1
R140	D5
R141	B4
R142,143	C4
R144	B4
R145	B3
R146	C5
R147,148	C1
R149	C3
R150	A3
R151	D5
T1	A4/5
T2	B4/5
V1	B2/3
V2	B2
V3	C2/3
V4,5	B2/3
V6,7	C2
V8,9	C2/3
V10,11	B3
V12	D4
V13	C/D4

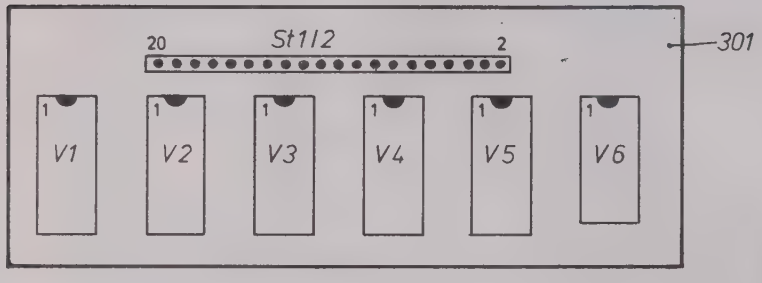
Part	Square
V14	C4
V15	C3
V16,17	B3
V18,19	D3
V20	A4
V21	C4
V22	B4
V23	C5
V24...26	B5
V27...29	C4
V30,31	B4
V32	B5
V33	B4
V34	A/B4
V35	B1
V36,37	C5
V38,39	B4
V40...42	D3
V43	A1
V44,45	B1
V46	C4/5
V47,48	A2
V49	A3
V50,51	B2
V52,53	A1
V54	B5
V55,56	C5
V57	A1/2
V58	A1
V59	B1
V60	D4
V61,62	A3
V63...66	B3
V67	C/D4
V68	D4
V69	D3/4
V76	B2
V77	D5
V78	C4/5
V79	B5
V80	C4
V81...83	B4



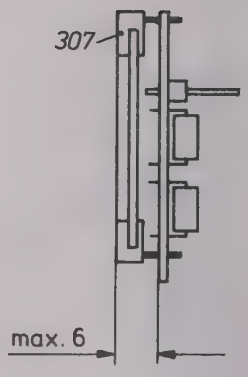
Wiring Diagram MA 5D
Display

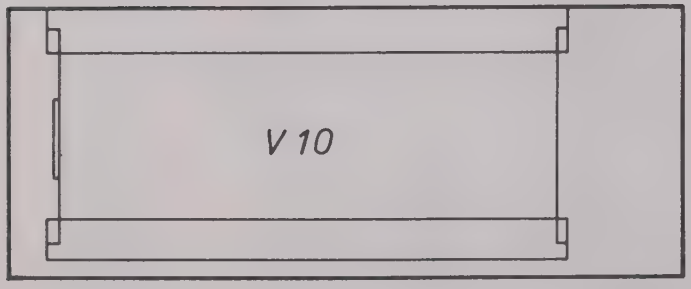


Parts side 2.582.467.01



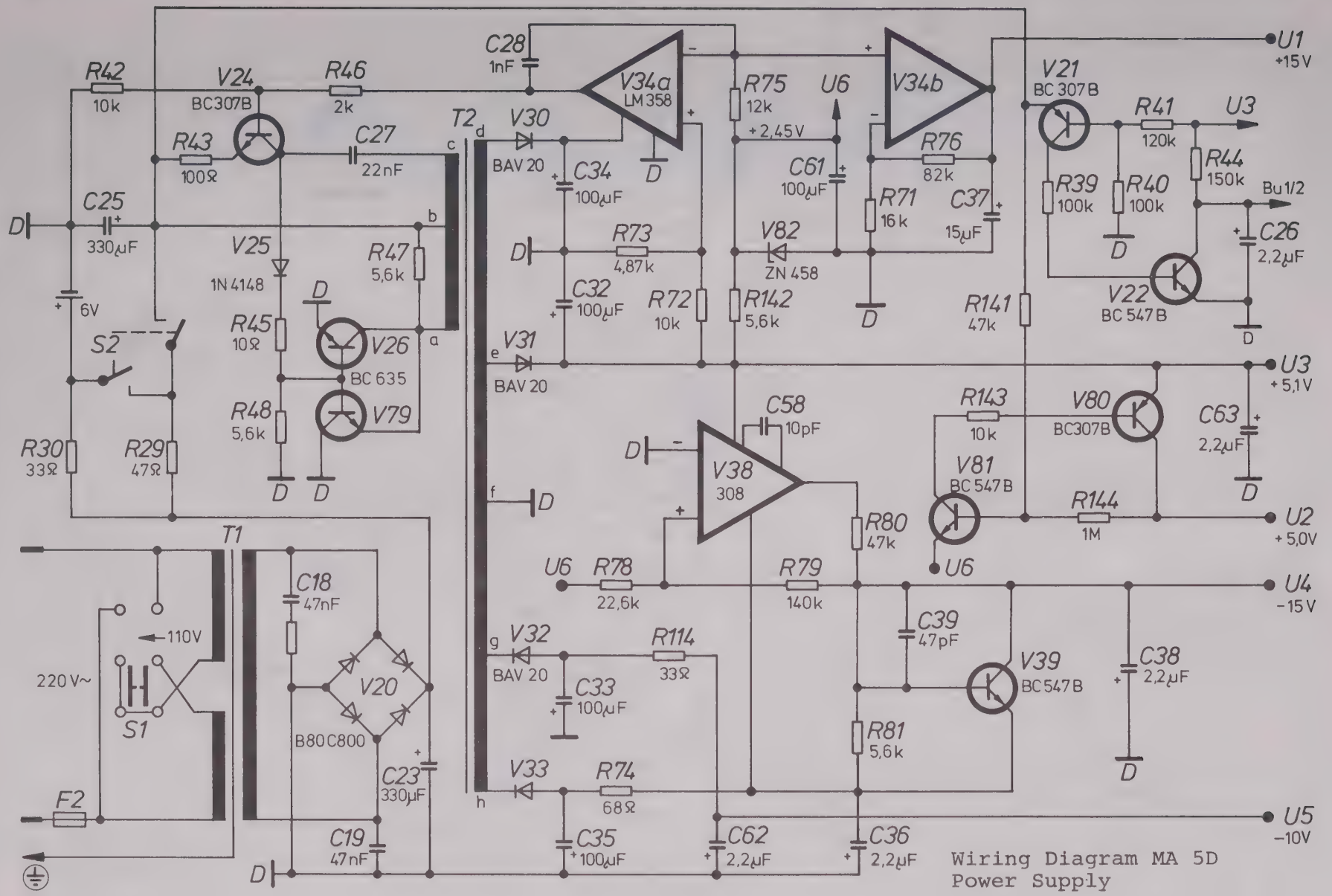
Parts side 2.582.467.02

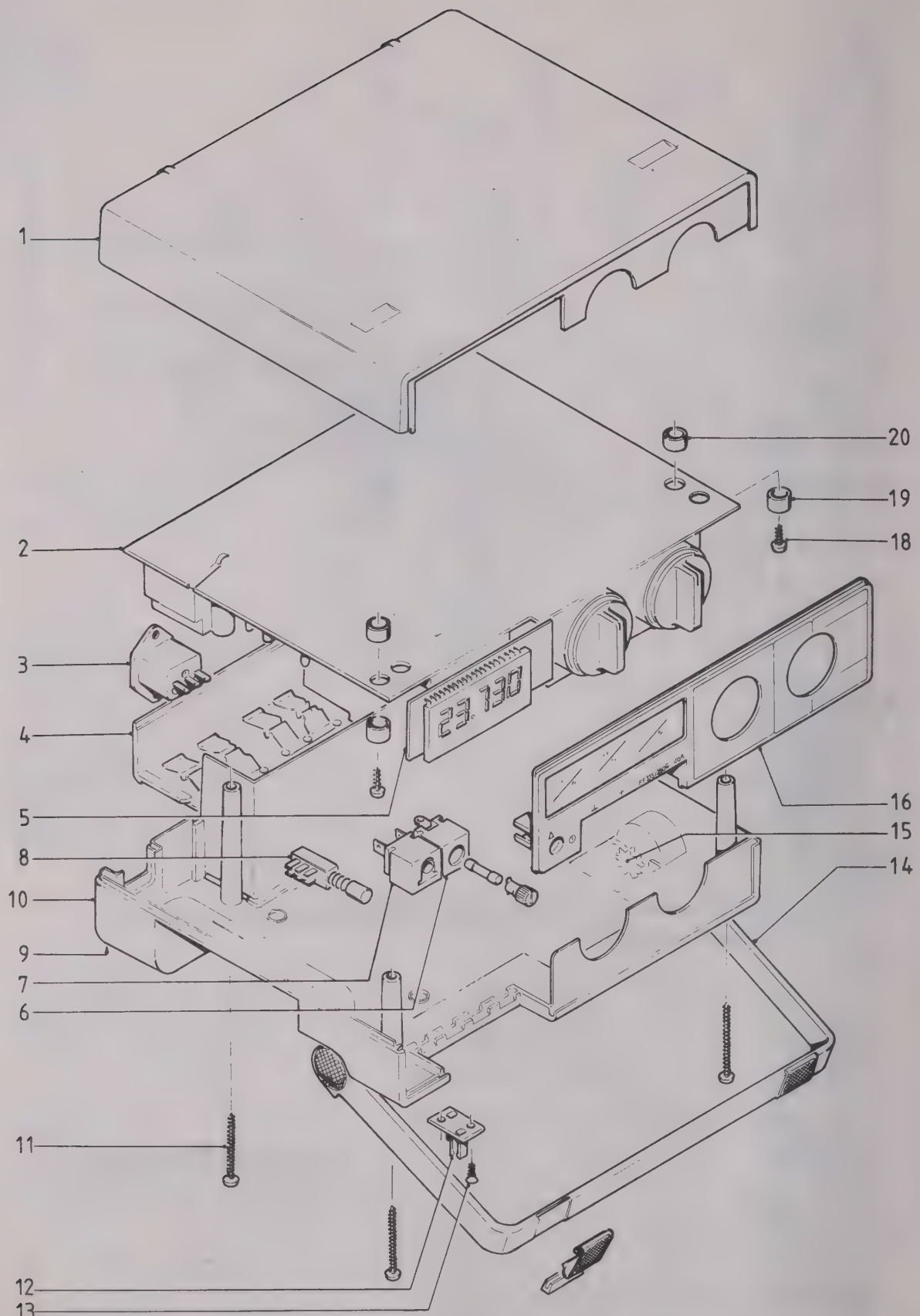




Soldering side

Circuit Board Display, equipped


R42 10k
V24 BC307B
R46 2k
C28 1nF
V34a LM358
R75 12k
U6
+2,45V
V34b
U1 +15V
V21 BC307B
R41 120k
U3
R43 100Ω
C27 22nF
T2
V30 BAV 20
C34 100µF
C61 100µF
R76 82k
R44 150k
Bu1/2
C25 330µF
R39 100k
R40 100k
C26 2,2µF
V25 1N4148
R73 4,87k
V82 ZN 458
R71 16k
C37 15µF
R47 5,6k
C32 100µF
R72 10k
R142 5,6k
R141 47k
V22 BC 547B
6V
S2
R45 10Ω
V26 BC 635
V31 BAV 20
U3 +5,1V
R48 5,6k
V79
C58 10pF
R143 10k
V80 BC307B
C63 2,2µF
R30 33Ω
R29 47Ω
V38 308
V81 BC 547B
R144 1M
U2 +5,0V
R80 47k
T1
U6
R78 22,6k
R79 140k
U4 −15V
110V
220V~
C18 47nF
V32 BAV 20
R114 33Ω
C39 47pF
C38 2,2µF
S1
V20 B80C800
C33 100µF
V39 BC547B
R81 5,6k
C23 330µF
V33
R74 68Ω
F2
C19 47nF
C35 100µF
C62 2,2µF
C36 2,2µF
U5 −10V
Wiring Diagram MA 5D
Power Supply



Assembly View MA 5D

Laufende Nummer, Item Number, Numéro en continu, Posición		Benennung, Description, Désignation, Desicripción	Sachnummer, Part No., Numéro de code Nó. de artícolo	B
	1	Part of case, pre-mounted	2.127.113.01	
1		Part of case, pre-mounted	2.127.113.02	
	2	Circuit board, equipped	2.582.466.01	1
2		Circuit board, equipped	2.582.466.02	2
	3	Plug B DIN 49 457	3.624.300.01	
3		Plug B DIN 49 457, with fuse	3.624.322.01	3
4	4	Battery cover, mounted	2.326.062.01	
	5	Circuit board Display, compl.	2.582.467.01	
5		Circuit board Display, compl.	2.582.467.02	
6	6	Fuse holder	2.578.011.01	4
7	7	Connection terminal, pre-mtd.	2.614.031.01	
8	8	Miniature pushbutton switch 1xF/FG, red	3.530.080.01	
9	9	Case foot	3.164.438.01	
10	10	Lower part of case	2.117.113.02	
11	11	Sheet metal screw BZ 2.9x32, DIN 7971	3.716.030.24	
12	12	Cable holder	3.326.419.01	
13	13	Sheet metal screw BZ 2.2x6.5, DIN 7971	3.716.022.24	
14	14	Handle	3.153.061.01	5
15	15	Toothed star	3.413.043.01	
16	16	Front panel, pre-mounted	3.322.033.01	
18	18	Sheet metal screw BZ 2.9x13, DIN 7971	3.716.021.24	
19	19	Sealing part	3.164.427.01	
20	20	Spacing ring	3.311.356.01	
21	21	Cable binder	3.326.227.01	

Design state A,B up to autumn '81

Design state C,D since autumn '81

B = Bemerkungen, Remarks, Remarque, Notas

1) Fuse F2 located behind mains transformer T1
2) Fuse F2 moved from circuit board to mains plug
3) G type melting fuse link M 0.032, DIN 41571 required
4) G type melting fuse link FF 3.15 required Part No. 3.578.152.02
5) 2 toothed stars, Item No. 15, required for this

List of Mechanical Parts MA 5D

Assembly View

Laufende Nummer, Item Number, Numéro en continu, Posición		Benennung, Description, Désignation, Desicripción	Sachnummer, Part No., Numéro de code Nó. de artícolo	B
	101	Circuit board, not equipped	3.582.379.01	
101		Circuit board, not equipped	3.582.379.02	
B1	B1	Oscillating quartz, 3.200 MHz ± 50 ppm	3.570.027.01	
Bu1		Spring strip, 7-pole	3.624.203.01	
Bu2		Spring strip, 12-pole	3.624.285.01	
	Bu1	Socket strip, 20-pole	3.624.299.01	
C1	C1	Plastic foil capacitor, 0.22 µF, 1000 V	3.577.277.01	
C2	C2	Ceramic foil capacitor, 15 pF, 2000 V	3.577.483.01	
C3	C3	Plastic foil capacitor, 100 pF, 400 V	3.577.488.01	
C4	C4	Plastic foil capacitor, 1000 pF, 400 V	3.577.303.01	
C5	C5	Ceramic capacitor, 1000 pF, 400 V	3.577.332.01	
C6	C6	Ceramic capacitor, 15 pF, 400 V	3.577.330.01	
C7	C7	Plastic foil capacitor, 470 pF, 630 V	3.577.245.01	
C8	C8	Plastic foil capacitor, 15 nF, 63 V	3.577.476.01	
C9	C9	Ceramic capacitor, 1000 pF, 400 V	3.577.332.01	
C10	C10	Ceramic capacitor, 9...100 pF, 250 V	3.577.490.01	
C11	C11	Ceramic capacitor, 2.2...22 pF, 250 V	3.577.489.01	
C12	C12	Ceramic capacitor, 2.2...22 pF, 250 V	3.577.489.01	
C13	C13	Ceramic capacitor, 9...100 pF, 250 V	3.577.490.01	
C14	C14	Ceramic capacitor, 10 pF, 63 V	3.577.484.01	
C15	C15	Ceramic capacitor, 2.2...22 pF, 250 V	3.577.489.01	
C16	C16	Tantalum electrolytic capacitor, 15 µF, 20 V	3.577.295.01	
C17	C17	Tantalum electrolytic capacitor, 15 µF, 20 V	3.577.295.01	
C18	C18	Ceramic capacitor, 47 nF, 63 V	3.577.351.01	

2.582.466.01 until autumn 1981
2.582.466.02 since autumn 1981

B = Bemerkungen, Remarks, Remarque, Notas

List of Electrical Parts MA 5D

Circuit Board, equipped

Laufende Nummer, Item Number, Numéro en continu, Posición	Benennung, Description, Désignation, Desicripción	Sachnummer, Part No., Numéro de code Nó. de artícolo	B
C19	Ceramic capacitor, 47 nF, 63 V	3.577.351.01	
C20	Ceramic capacitor, 1000 pF, 400 V	3.577.332.01	
C21	Tantalum electrolytic capacitor, 2.2 µF, 35 V	3.577.348.01	
C22	Tantalum electrolytic capacitor, 1.5 µF, 35 V	3.577.349.01	
C23	Aluminium electrolytic capacitor, 330 µF, 25 V	3.577.481.01	
C24	Tantalum electrolytic capacitor, 2.2 µF, 35 V	3.577.348.01	
C25	Aluminium electrolytic capacitor, 330 µF, 25 V	3.577.481.01	
C26	Tantalum electrolytic capacitor, 2.2 µF, 35 V	3.577.348.01	
C27	Plastic foil capacitor, 22 nF, 250 V	3.577.032.01	
C28	Ceramic capacitor, 1000 pF, 400 V	3.577.332.01	
C29	Ceramic capacitor, 0.1 µF, 30 V	3.577.390.01	
C30	Ceramic capacitor, 1000 pF, 400 V	3.577.332.01	
C31	Ceramic capacitor, 0.1 µF, 30 V	3.577.390.01	
C32	Aluminium electrolytic capacitor, 100 µF, 35 V	3.577.480.01	
C33	Aluminium electrolytic capacitor, 100 µF, 35 V	3.577.480.01	
C34	Aluminium electrolytic capacitor, 100 µF, 35 V	3.577.480.01	
C35	Aluminium electrolytic capacitor, 100 µF, 35 V	3.577.480.01	
C36	Tantalum electrolytic capacitor, 2.2 µF, 35 V	3.577.348.01	
C37	Tantalum electrolytic capacitor, 15 µF, 20 V	3.577.295.01	
C38	Tantalum electrolytic capacitor, 15 µF, 20 V	3.577.295.01	
C39	Ceramic capacitor, 47 pF, 400 V	3.577.325.01	
C40	Plastic foil capacitor, 22 nF, 250 V	3.577.032.01	
C41	Ceramic capacitor, 47 pF, 400 V	3.577.325.01	
C42	Ceramic capacitor, 47 pF, 400 V	3.577.325.01	
C43	Plastic foil capacitor, 1 µF, 63 V	3.577.479.01	

2.582.466.01/02

B = Bemerkungen, Remarks, Remarque, Notas

List of Electrical Parts MA 5D

Circuit Board, equipped

Laufende Nummer, Item Number, Numéro en continu, Posición		Benennung, Description, Désignation, Desicripción	Sachnummer, Part No., Numéro de code Nó. de artícolo	B
C44	C44	Ceramic capacitor, 10 pF, 63 V	3.577.484.01	
C45	C45	Plastic foil capacitor, 0.22 µF, 250 V	3.577.478.01	
C46	C46	Tantalum electrolytic capacitor, 2.2 µF, 35 V	3.577.348.01	
C47	C47	Ceramic capacitor, 0.1 µF, 30 V	3.577.390.01	
C48	C48	Ceramic capacitor, 0.1 µF, 30 V	3.577.377.01	
C49	C49	Ceramic capacitor, 3 pF, 500 V	3.577.377.01	
C50	C50	Ceramic capacitor, 220 pF, 400 V	3.577.315.01	
C51	C51	Ceramic capacitor, 220 pF, 400 V	3.577.315.01	
C52	C52	Ceramic capacitor, 0.1 µF, 30 V	3.577.390.01	
C53	C53	Plastic foil capacitor, 1.5 µF, 63 V	3.577.302.01	
C54	C54	Tantalum electrolytic capacitor, 15 µF, 20 V	3.577.295.01	
C55	C55	Tantalum electrolytic capacitor, 2.2 µF, 35 V	3.577.348.01	
C56	C56	Tantalum electrolytic capacitor, 2.2 µF, 35 V	3.577.348.01	
C57	C57	Ceramic capacitor, 100 pF, 63 V	3.577.378.01	
C58	C58	Ceramic capacitor, 100 pF, 63 V	3.577.378.01	
C59	C59	Plastic foil capacitor, 4700 pF, 63 V	3.577.394.01	
C60	C60	Plastic foil capacitor, 100 pF, 63 V	3.577.378.01	
C61	C61	Aluminium electrolytic capacitor, 100 µF, 10 V	3.577.497.01	
C62	C62	Tantalum electrolytic capacitor, 2.2 µF, 35 V	3.577.348.01	
C63	C63	Tantalum electrolytic capacitor, 2.2 µF, 35 V	3.577.348.01	
C64	C64	Tantalum electrolytic capacitor, 2.2 µF, 35 V	3.577.348.01	
C65	C65	Tantalum electrolytic capacitor, 2.2 µF, 35 V	3.577.348.01	
C66	C66	Tantalum electrolytic capacitor, 2.2 µF, 35 V	3.577.348.01	
C67	C67	Ceramic capacitor, 220 pF, 400 V	3.577.315.01	
C68		Ceramic capacitor, 0.1 µF, 30 V	3.577.390.01	

2.582.466.02 | 2.582.466.01

B = Bemerkungen, Remarks, Remarque, Notas

List of Electrical Parts MA 5D

Circuit Board, equipped

Laufende Nummer, Item Number, Numéro en continu, Posición									Benennung, Description, Désignation, Desicripción	Sachnummer, Part No., Numéro de code Nó. de artícolo	B
								F2	Fuse holder	3.578.154.01	1
								F2	G type melting fuse M 0.032C	DIN 41 571	1
							F3	F3	Protective spark gap	3.557.067.01	2
							R1	R1	Metal film resistor, 0.25 W, 900 Ω , 0.1%	3.561.025.21	
							R2	R2	Metal film resistor, 0.25 W, 90 Ω , 0.1%	3.561.025.11	
							R3	R3	Metal film resistor, 0.5 W, 9 Ω , 0.1%	3.561.025.61	
							R4	R4	Coil resistor, complete, 0.9 Ω , 0.1%	2.634.009R01	
							R5	R5	Shunt, 90 m	3.542.051.01	
							R6	R6	Shunt, 20 m	3.542.050P01	
							R7	R7	Carbon film resistor, 0.25 W, 47 kΩ , 5%	3.561.055.01	
							R8	R8	Carbon film resistor, 0.25 W, 10 kΩ , 5%	3.561.058.01	
							R9-R12	R9-R12	Resistance network 4 Div 5 SIL	3.560.032.01	
							R13	R13	Metal film resistor, 0.25 W, 16 kΩ , 1%	3.561.030.02	
							R14	R14	Metal film resistor, 0.25 W, 39 kΩ , 1%	3.561.450.01	
							R15	R15	Carbon film resistor, 0.25 W, 470 kΩ , 5%	3.561.958.01	
							R16	R16	Carbon film resistor, 0.25 W, 220 kΩ , 5%	3.561.707.01	
							R17	R17	Carbon film resistor, 0.25 W, 47 kΩ , 5%	3.561.055.01	
							R18	R18	Carbon film resistor, 0.25 W, 470 kΩ , 5%	3.561.058.01	
							R19	R19	Metal film resistor, 0.25 W, 4.53 kΩ , 1%	3.561.517.02	
							R20	R20	Metal film resistor, 0.25 W, 3 kΩ , 1%	3.561.502.02	
							R21	3)	Carbon film resistor, 0.25 W, 47 kΩ , 5%	3.561.055.01	
							R22	R22	Carbon film resistor, 0.25 W, 180 kΩ , 5%	3.561.376.01	
							R23	R23	Metal film resistor, 0.25 W, 27 kΩ , 1%	3.561.999.01	

								2.582.466.02	2.582.466.01

B = Bemerkungen, Remarks, Remarque, Notas

1) With 2.582.466.02, fuse holder in mains connector, Item No. 14

2) Soldered onto input sockets

3) With 2.582.466.01: R21 Metal film resistor 0.25 W, 22.1 k , 1%
3.561.600.01

List of Electrical Parts MA 5D

Circuit Board, equipped

Laufende Nummer, Item Number, Numéro en continu, Posición	Benennung, Description, Désignation, Desicripción	Sachnummer, Part No., Numéro de code Nó. de artícolo	B
R24	Carbon film potentiometer, 0.5 W, 1 kΩ , 20%	3.569.017.01	
R25	Metal film resistor, 0.5 W, 100 kΩ , 5%	3.561.024.71	
R26	Carbon film potentiometer, 0.5 W, 220Ω , 20%	3.569.015.01	
R27	Carbon film resistor, 0.25 W, 10 kΩ , 5%	3.561.058.01	
R28	Carbon film resistor, 0.25 W, 24 kΩ , 5%	3.561.719.01	
R29	Carbon film resistor, 0.5 W, 47Ω , 5%	3.561.284.02	
R30	Metal film resistor, 0.5 W, 33Ω , 1%	3.561.028.21	
R31	Carbon film resistor, 0.25 W, 470 kΩ , 5%	3.561.958.01	
R32	Carbon film resistor, 0.25 W, 240 Ω , 5%	3.561.764.01	
R33	Carbon film potentiometer, 0.5 W, 220 kΩ , 20%	3.569.114.01	
R34	Metal film resistor, 0.25 W, 1 MΩ , 0.1%	3.561.025.51	
R35	Metal film resistor, 0.25 W, 100 kΩ , 0.1%	3.561.009.71	
R36	Metal film resistor, 0.25 W, 10 kΩ , 0.1%	3.561.009.61	
R37	Metal film resistor, 0.25 W, 1 kΩ , 0.1%	3.561.756.02	
R38	Metal film resistor, 0.25 W, 100Ω , 0.1%	3.561.777.02	
R39	Carbon film resistor, 0.25 W, 100 kΩ , 5%	3.561.239.01	
R40	Metal film resistor, 0.25 W, 91 kΩ , 2%	3.561.358.01	
R41	Metal film resistor, 0.25 W, 47 kΩ , 1%	3.561.590.01	
R42	Carbon film resistor, 0.25 W, 10 kΩ , 5%	3.561.058.01	
R43	Carbon film resistor, 0.25 W, 100Ω , 5%	3.561.059.01	
R44	Carbon film resistor, 0.25 W, 150 kΩ , 5%	3.561.247.01	
R45	Carbon film resistor, 0.25 W, 10Ω , 5%	3.561.120.01	
R46	Carbon film resistor, 0.25 W, 2 kΩ , 5%	3.561.139.01	
R47	Carbon film resistor, 0.25 W, 5.6 kΩ , 5%	3.561.253.01	
R48	Carbon film resistor, 0.25 W, 5.6 kΩ , 5%	3.561.253.01	

2.582.466.01/02

B = Bemerkungen, Remarks, Remarque, Notas

List of Electrical Parts MA 5D

Circuit Board, equipped

Laufende Nummer, Item Number, Numéro en continu, Posición	Benennung, Description, Désignation, Desicripción	Sachnummer, Part No., Numéro de code Nó. de artícolo	B
R49	Metal film resistor, 0.25 W, 68 kΩ , 2%	3.561.493.01	
R50	Metal film resistor, 0.25 W, 62 kΩ , 1%	3.561.025.41	
R51	Carbon film potentiometer, 0.5 W, 2.2 kΩ , 20%	3.569.012.01	
R52	Metal film resistor, 0.25 W, 36 kΩ , 2%	3.561.482.01	
R53	Carbon film potentiometer, 0.5 W, 100 kΩ , 20%	3.569.053.01	
R54	Metal film resistor, 0.25 W, 22k...511 kΩ , 2%		1
R55	Carbon film resistor, 0.25 W, 200Ω , 5%	3.561.309.01	2
R56	Carbon film resistor, 0.25 W, 10 kΩ , 5%	3.561.058.01	
R57	Carbon film resistor, 0.25 W, 240Ω , 5%	3.561.764.01	
R58	Carbon film resistor, 0.25 W, 3 kΩ , 5%	3.561.330.01	
R59	Carbon film potentiometer, 0.5 W, 220 Ω , 20%	3.569.015.01	
R60	Metal film resistor, 0.25 W, 1.8 kΩ , 2%	3.561.144.01	
R61	Carbon film resistor, 1 W, 130 k Ω , 5%	3.561.024.91	
R62	Carbon film resistor, 1 W, 130 kΩ , 5%	3.561.024.91	
R64	Carbon film resistor, 0.25 W, 220 kΩ , 5%	3.561.707.01	
R65	Carbon film resistor, 0.25 W, 100 kΩ , 5%	3.561.239.01	
R66	Carbon film resistor, 0.25 W, 5.6 kΩ , 5%	3.561.253.01	
R67	Carbon film resistor, 0.25 W, 24 kΩ , 5%	3.561.719.01	
R68	Coil resistor B 500 Ω Cu, bifilar	3.565.168.01	
R69	Carbon film resistor, 0.25 W, 33 kΩ , 5%	3.561.061.01	
R70	Carbon film resistor, 0.25 W, 47 kΩ , 5%	3.561.055.01	
R71	Metal film resistor, 0.25 W, 16 kΩ , 1%	3.561.030.02	
R72	Metal film resistor, 0.25 W, 27 kΩ , 1%	3.561.999.01	
R73	Metal film resistor, 0.25 W, 9.1 kΩ , 1%	3.561.005.61	

2.582.466.01/02

B = Bemerkungen, Remarks, Remarque, Notas

1) For balancing

2) With some circuit boards 120 3.561.221.01

List of Electrical Parts MA 5D

Circuit Board, equipped

Laufende Nummer, Item Number, Numéro en continu, Posición	Benennung, Description, Désignation, Desicripción	Sachnummer, Part No., Numéro de code Nó. de artícolo	B
R74	Metal film resistor, 0.5 W, 68 Ω , 1%	3.561.749.01	
R75	Carbon film resistor, 0.25 W, 12 kΩ , 5%	3.561.611.01	
R76	Metal film resistor, 0.25 W, 82 kΩ , 2%	3.561.893.01	
R78	Metal film resistor, 0.25 W, 22.6 kΩ , 1%	3.561.015.21	
R79	Metal film resistor, 0.25 W, 140 kΩ , 1%	3.561.020.21	
R80	Carbon film resistor, 0.25 W, 47 kΩ , 5%	3.561.055.01	
R81	Carbon film resistor, 0.25 W, 5.6 kΩ , 5%	3.561.253.01	
R82	Carbon film resistor, 0.25 W, 15 kΩ , 5%	3.561.236.01	
R83	Carbon film resistor, 0.25 W, 2 kΩ , 5%	3.561.139.01	
R84			
R85			
R86	Resistance network, 6 x 270 kΩ , 7 SIL	3.560.011.01	
R87			
R88			
R89	Carbon film resistor, 0.25 W, 10 kΩ , 5%	3.561.058.01	
R90	Metal film resistor, 0.25 W, 36 Ω , 1%	3.561.233.01	
R91	Carbon film resistor, 0.25 W, 4.7 MΩ , 5%	3.561.634.01	
R92	Carbon film potentiometer, 0.5 W, 1 MΩ , 20%	3.569.071.01	
R93	Carbon film resistor, 0.25 W, 100 kΩ , 5%	3.561.239.01	
R94	Carbon film resistor, 0.5 W, 100 kΩ , 20%	3.569.053.01	
R95	Carbon film resistor, 0.25 W, 24 kΩ , 5%	3.561.719.01	
R96	Carbon film resistor, 0.25 W, 220 kΩ , 5%	3.561.707.01	
R97	Metal film resistor, 0.25 W, 120Ω ...953Ω , 1%		1
R98	Metal film resistor, 0.1 W, 14 kΩ , 0.5%	3.561.022.51	

2.582.466.01/02

B = Bemerkungen, Remarks, Remarque, Notas

1) For balancing

List of Electrical Parts MA 5D

Circuit Board, equipped

Laufende Nummer, Item Number, Numéro en continu, Posición	Benennung, Description, Désignation, Desicripción	Sachnummer, Part No., Numéro de code Nó. de artícolo	B
R99	Cermet potentiometer, 0.75 W, 100 Ω , 10%	3.569.232.01	
R 100	Metal film resistor, 0.1 W, 10 kΩ , 0.5%	3.561.022.41	
R101	Carbon film resistor, 0.25 W, 220 kΩ , 5%	3.561.707.01	
R102	Carbon film resistor, 0.25 W, 2 kΩ , 5%	3.561.139.01	
R103	Carbon film resistor, 0.25 W, 13 MΩ, 5%	3.561.498.02	
R104	Metal film resistor, 0.25 W, 3 kΩ , 1%	3.561.502.02	
R105	Metal film resistor, 0.25 W, 26.4 kΩ , 1%	3.561.336.01	
R106	Metal film resistor, 0.25 W, 140 kΩ , 1%	3.561.020.21	
R107	Carbon film resistor, 0.25 W, 62 Ω , 5%	3.561.323.01	
R108	Carbon film resistor, 0.25 W, 220 kΩ , 5%	3.561.707.01	
R109	Metal film resistor, 0.25 W, 120 Ω ...953Ω , 1%		1
R110	Metal film resistor, 0.1 W, 14.2 kΩ , 0.5%	3.561.022.61	
R111	Cermet potentiometer, 0.75 W, 100 Ω , 10%	3.569.232.01	
R112	Metal film resistor, 0.25 W, 6.8 Ω , 1%	3.561.250.01	
R113	Metal film resistor, 0.1 W, 620 Ω , 0.5%	3.561.022.31	
R114	Carbon film resistor, 0.25 W, 33 Ω , 5%	3.561.753.01	
R115	Metal film resistor, 0.25 W, 1.6 kΩ , 1%	3.561.451.02	
R116	Metal film resistor, 0.25 W, 26.4 kΩ , 1%	3.561.336.01	
R117	Metal film resistor, 0.25 W, 22.1 kΩ , 1%	3.561.600.01	
R118	Carbon film resistor, 0.25 W, 8.2 kΩ , 5%	3.561.664.01	
R119	Carbon film resistor, 0.25 W, 8.2 MΩ, 5%	3.561.208.01	
R120	Carbon film resistor, 0.25 W, 24 kΩ , 5%	3.561.719.01	
R121	Carbon film resistor, 0.25 W, 100 kΩ , 5%	3.561.239.01	
R122	Metal film resistor, 0.25 W, 33 kΩ , 2%	3.561.566.01	
R123	Metal film resistor, 0.25 W, 47 kΩ , 1%	3.561.590.01	

2.582.466.01/02

B = Bemerkungen, Remarks, Remarque, Notas

1) For balancing

List of Electrical Parts MA 5D

Circuit Board, equipped

Laufende Nummer, Item Number, Numéro en continu, Posición	Benennung, Description, Désignation, Desicripción	Sachnummer, Part No., Numéro de code Nó. de artícolo	B
R124	Carbon film resistor, 0.25 W, 18 kΩ , 5%	3.561.052.01	
R125	Carbon film resistor, 0.25 W, 220 kΩ , 5%	3.561.707.01	
R126	Carbon film resistor, 0.25 W, 4.7 MΩ , 5%	3.561.634.01	
R127	Carbon film resistor, 0.25 W, 24 kΩ , 5%	3.561.719.01	
R128	Carbon film resistor, 0.25 W, 24 kΩ , 5%	3.561.719.01	
R129	Carbon film resistor, 0.25 W, 220 kΩ , 5%	3.561.707.01	
R130	Carbon film resistor, 0.25 W, 100 kΩ , 5%	3.561.239.01	
R131	Carbon film resistor, 0.25 W, 100 kΩ , 5%	3.561.239.01	
R132	Carbon film resistor, 0.25 W, 100 kΩ , 5%	3.561.239.01	
R133	Carbon film resistor, 0.25 W, 24 kΩ , 5%	3.561.719.01	
R134	Carbon film resistor, 1 W, 130 kΩ , 5%	3.561.024.91	
R135	Carbon film resistor, 1 W, 130 kΩ , 5%	3.561.024.91	
R137	Metal film resistor, 0.25 W, 62 Ω , 1%	3.561.798.01	
R138	Shunt, 20 m	3.542.050P01	
R139	Metal film resistor, 0.25 W, 620 Ω , 2%	3.561.143.01	
R140	Carbon film resistor, 0.25 W, 470 kΩ , 5%	3.561.958.01	
R141	Carbon film resistor, 0.25 W, 47 kΩ , 5%	3.561.055.01	
R142	Carbon film resistor, 0.25 W, 1.3 kΩ , 5%	3.561.358.01	
R143	Carbon film resistor, 0.25 W, 10 kΩ , 5%	3.561.058.01	
R144	Carbon film resistor, 0.25 W, 1 MΩ , 5%	3.561.072.01	
R145	Carbon film resistor, 0.25 W, 5.6 kΩ , 5%	3.561.253.01	
R146	Carbon film resistor, 0.25 W, 3 kΩ , 5%	3.561.330.01	
R147	Metal film resistor, 0.1 W, 1 kΩ , 0.05%	3.561.022.81	
R148	Metal film resistor, 0.5 W, 100 kΩ , 0.05%	3.561.022.71	

2.582.466.01/02

B = Bemerkungen, Remarks, Remarque, Notas

List of Electrical Parts MA 5D

Circuit Board, equipped

Laufende Nummer, Item Number, Numéro en continu, Posición	Benennung, Description, Désignation, Desicripción	Sachnummer, Part No, Numéro de code Nó. de artícolo	B
R149	Carbon film resistor, 0.25 W, 4.7 MΩ, 5%	3.561.634.01	
R150	Carbon film resistor, 0.25 W, 56 kΩ, 5%	3.561.245.01	
R151	Carbon film resistor, 0.25 W, 10 kΩ, 5%	3.561.058.01	
T1	Mains transformer, 4.5 VA	3.520.015.01	
T2	Transformer RM7	2.520.215.02	
V1	Diode 1N 5405	3.575.249.01	
V2	Diode 1N 5405	3.575.249.01	
V3	Diode 1N 5405	3.575.149.01	
V4	Diode 1N 5405	3.575.249.01	
V5	Diode 1N 5405	3.575.249.01	
V6	Diode 1N 5405	3.575.249.01	
V7	Diode 1N 5406 SEL	3.575.253.01	
V8	Diode 1N 5406 SEL	3.575.253.01	
V9	Diode 1N 5405	3.575.249.01	
V10	Diode 1N 4148	3.575.159.01	
V11	Diode 1N 4148	3.575.159.01	
V12	Transistor BC 307B	3.575.174.01	
V13	Transistor BF 423	3.575.255.01	
V14	Transistor BF 423	3.575.255.01	
V15	Diode 1N 4005	3.575.166.01	

2.582.466.01/02

B = Bemerkungen, Remarks, Remarque, Notas

List of Electrical Parts MA 5D

Circuit Board, equipped

Laufende Nummer, Item Number, Numéro en continu, Posición	Benennung, Description, Désignation, Desicripción	Sachnummer, Part No., Numéro de code Nó. de artícolo	B
V16	FET transistor J 113	3.575.256.01	
V17	IC amplifier LF 351B	3.576.190.01	
V18	Transistor BC 547B	3.575.114.01	
V19	Transistor BC 547B	3.575.114.01	
V20	Rectifier B80 C800	3.575.170.01	
V21	Transistor BC 307B	3.575.174.01	
V22	Transistor BC 547B	3.575.114.01	
V23	Transistor BC 547C	3.575.243.01	
V24	Transistor BC 307B	3.575.174.01	
V25	Diode 1N 4148	3.575.159.01	
V26	Transistor BC 635	3.575.254.01	
V27	FET transistor J 113	3.575.256.01	
V28	IC amplifier TL 080 CP	3.576.193.01	
V29	IC amplifier CA 3130S	3.576.159.01	
V30	Diode BAV 20	3.575.092.01	
V31	Diode BAV 20	3.575.092.01	
V32	Diode BAV 20	3.575.092.01	
V33	Diode BAV 20	3.575.092.01	
V34	IC amplifier LM 358	3.576.191.01	
V35	IC amplifier LM 358	3.576.191.01	
V36	Transistor BC 307B	3.575.174.01	
V37	Transistor BC 307B	3.575.174.01	
V38	IC amplifier 308	3.576.160.01	
V39	Transistor BC 547B	3.575.114.01	
V40	Diode 1N 4148	3.575.159.01	

2.582.466.01/02

B = Bemerkungen, Remarks, Remarque, Notas

List of Electrical Parts MA 5D

Circuit Board, equipped

Laufende Nummer, Item Number, Numéro en continu, Posición	Benennung, Déscription, Désignation, Desicripción	Sachnummer, Part No., Numéro de code Nó. de artícolo	B
V41	Transistor BC 307B	3.575.174.01	
V42	Diode 1N 4148	3.575.159.01	
V43	IC AD 536 AKH	3.576.186.01	
V44	Diode EPAD 50	3.575.210.01	
V45	Diode EPAD 50	3.575.210.01	
V46	IC-MOS 4001 BE	3.576.039.01	
V47	IC-MOS ICL 8053 A	3.576.187.01	
V48	Diode 1N 4148	3.575.159.01	
V49	Diode 1N 4148	3.575.159.01	
V50	IC amplifier AD 542 JH	3.576.189.01	
V51	IC amplifier LF 351B	3.576.190.01	
V52	Transistor BFT 10	3.575.189.01	
V53	Transistor BFT 10	3.575.189.01	
V54	IC-MOS 4007 AE	3.576.049.01	
V55	IC-MOS 4040 BP	3.576.192.01	
V56	IC-MOS 4040 BP	3.576.192.01	
V57	Zener diode 2.45 V, 1.5%, Tk 30	3.575.251.01	
V58	Transistor BC 547C	3.575.243.01	
V59	FET transistor J 113	3.575.256.01	
V60	IC-MOS 4011 BE	3.576.047.01	
V61	IC amplifier TAA 761A	3.576.038.01	
V62	IC amplifier CA 3130S	3.576.159.01	
V63	Transistor BC 307B	3.575.174.01	
V64	Transistor BC 307B	3.575.174.01	
V65	Diode 1N 4148	3.575.159.01	

2.582.466.01/02

B = Bemerkungen, Remarks, Remarque, Notas

List of Electrical Parts MA 5D

Circuit Board, equipped

Laufende Nummer, Item Number, Numéro en continu, Posición		Benennung, Description, Désignation, Desicripción	Sachnummer, Part No., Numéro de code Nó. de artícolo	B
V66	V66	Transistor BC 307B	3.575.174.01	
V67	V67	IC-MOS 4011 BE	3.576.047.01	
V68	V68	IC-MOS 4015 AE	3.576.040.01	
V69	V69	IC-MOS 4070 BE	3.576.062.01	
V76	V76	Transistor 2N 4119	3.575.252.01	
V77	V77	IC-MOS 4049 BE	3.576.036.01	
V78	V78	IC-MOS AY-3-3550	3.576.188.01	
V79	V79	Transistor BC 635	3.575.254.01	
V80	V80	Transistor BC 307B	3.575.174.01	
V81	V81	Transistor BC 547B	3.575.114.01	
V82	V82	Zener diode, 2.45 V	3.575.235.01	
V83		Zener diode ZPD 2.7	3.575.238.01	

2.582.466.02 2.582.466.01

B = Bemerkungen, Remarks, Remarque, Notas

List of Electrical Parts MA 5D

Circuit Board, equipped

Laufende Nummer, Item Number, Numéro en continu, Posición	Benennung, Description, Désignation, Desicripción	Sachnummer, Part No., Numéro de code Nó. de artícolo	B
216	Heat sink 33 °C/W	3.164.225.01	1
221	Shielding	3.164.430.01	
222	Shielding	3.164.431.01	
224	Battery contact	3.533.178.01	
225	Battery contact	3.533.178.02	
226	Contact spring	3.533.185.01	
228	Switch, mounted	2.535.027.01	
229	Switch, mounted	2.535.027.02	
231	Soldering pin	3.623.110.01	
233	Spacing disk	3.631.033.01	
234	Spacing disk	3.631.033.02	
236	Sliding switch	3.530.081.01	
238	Flatpin connector 2.8-1, DIN 46 247	3.624.206.34	2

2.582.466.01/02

B = Bemerkungen, Remarks, Remarque, Notas

1) For V43

2) For V1...V9

List of Electrical Parts MA 5D

Circuit Board, equipped

Laufende Nummer, Item Number, Numéro en continu, Posición		Benennung, Description, Désignation, Desicripción	Sachnummer, Part No., Numéro de code Nó. de artícolo	B
	301	Circuit board, not equipped	3.582.338.01	
301		Circuit board, not equipped	3.582.449.01	
307	307	Socket strip for V10	3.624.315.03	
St1		Pin strip, 7-pole	3.624.205.01	
St2		Pin strip, 12-pole	3.624.283.01	
	St1 St2	Pin strip, 20-pole	3.624.304.01	
V1	V1	IC 14 543 BCP	3.576.164.01	
V2	V2	IC 14 543 BCP	3.576.164.01	
V3	V3	IC 14 543 BCP	3.576.164.01	
V4	V4	IC 14 543 BCP	3.576.164.01	
V5	V5	IC 14 543 BCP	3.576.164.01	
V6	V6	IC 4070 BE	3.576.062.01	
V10	V10	LC-display, 6-digit	3.575.250.01	

2.582.467.01 until autumn '81
2.582.467.02 since autumn '81

B = Bemerkungen, Remarks, Remarque, Notas

List of Electrical Parts MA 5D

Circuit Board Display, equipped

MP MASTER
MA34330

BBC BROWN BOVERI GOERZ METRAWATT

METRAWATT GMBH
THOMAS-MANN-STRASSE 16-20
D-8500 NÜRNBERG
TELEFON (09 11) 86 02 -1
TELEX 06-23 729

GOERZ ELECTRO GES. M.B.H.
SONNLEITHNERGASSE 5
A-1101 WIEN
TELEFON (02 22) 64 36 66
TELEX 1 33 161

350 11. 81 SD